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14 September 1979

USSR Report

MILITARY AFFAIRS

(FOUO 23/79)

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USSR REPORT

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CONTENTS PAGE

TANK NAVIGATION SYSTEMS

Moscow TANKOVYYE NAVIGATSIONNYYE SISTEMY in Russian 1978, pp 16-34

[Chapter 1, Section 2 of book by M. I. Kuznetsov; illustrations not reproduced]

[Text] 1.2. Types of Tank Navigation Systems and Their Uses

For the solution of navigational problems, tank and motorized rifle subunits and units use the following types of navigation systems:

--the Yantar'-Trassa tank navigation apparatus;

--the TNA-2 tank navigation apparatus;

--the TNA-3 tank navigation apparatus;

--the GPK-59 directional gyroscope.

The equipment provided for use with the above navigation apparatus includes:

--the PAB-2A artillery director with the ANB-1 azimuthal crossbeam;

--a 20- or 50-meter measuring tape;

--a milrule and calipers.

Directional angles or side angles to targets are measured by a special angle gage mounted on the vehicle. Azimuthal indicators are used for this purpose in tanks.

We will briefly describe the general layout and control elements of the navigation systems and instruments listed above.

1.2.1 The Yantar'-Trassa Tank Navigation Apparatus

The Yantar'-Trassa tank navigation apparatus is used to determine the position coordinates and bearing of a vehicle while it is in motion and to record on a topographical map the path covered by it.

The Yantar'-Trassa apparatus comprises: the KM-2 gyroscopic course indicator, a path sensor, the KP-2M1 course plotter, a PM-3 converter, an MG-12 motor-generator and a control panel.

The MK-2 gyroscopic course indicator is used to measure the angular displacement of the vehicle and to calculate its bearing. It consists of a three-frame gyroscope in a gimbal mount, an azimuthal correction device, a horizontal correction device and a sine-cosine resolver (sensor for transmitting the directional angle).

The three-frame gyroscope maintains its outer frame and the attached rotor of the sine-cosine resolver motionless as the vehicle is turned. To increase its accuracy, the interior frame consists of a vacuum gyro casing, with the vacuum monitored by a vacuum meter. The vacuum in the gyro casing is maintained via a nozzle to which is attached a hose from a vacuum pump which is part of the apparatus.

The gyro case cover has a glass window for observing the direction of rotation of the rotor. The direction is determined from spirals painted on the rotor in black. If the rotor is rotating clockwise, the observer sees a spiral moving away from the center. The spiral is visible only when the gyro is being started or stopped, i.e. when it is rotating at slow speed.

The azimuthal correction device is used for latitude correction of the gyroscope and consists of a dial and weight attached to the gyro casing shaft by a micrometer thread in a position coaxial with the main gyroscope axis. The dial has 25 divisions and is kept from turning by a screw.

The horizontal correction device maintains the main gyroscope axis in the horizontal plane and consists of a pendulum with electrical contacts; when the main axis deviates from the horizontal plane these turn on an electric motor, producing a torque in the outer frame which returns the main axis to the horizontal plane.

The sine-cosine resolver (SKVT) measures the angular displacement of the vehicle. For this purpose, the rotor is rigidly attached to the outer gyroscope frame and is held motionless, while the stator is attached to the chassis of the vehicle and turns with it.

On the top cover of the gyroscopic course indicator is a knob for setting the course, and a course bearing dial is located under the glass cover. On the lower part of the indicator is a knob for arresting the gyroscope. The gyroscope has two lights, ARREST and BRAKE, for monitoring its operation.

The path sensor measures the speed of movement of the vehicle and transmits it to the course plotter. It consists of a selsyn transmitter and an electromagnetic clutch.

The KP-2M1 course plotter calculates the position coordinates and bearing of the vehicle and plots its path on a map.

The face panel has the following scales: an odometer, X and Y coordinates, path correction coefficient, map scale, and direction. On the lower left corner is a light which indicates that the pen has reached the edge of the plotting board.

On the front wall of the case are the COURSE knob for setting the bearings, knobs for moving the pen carriage and setting the coordinates, the PATH CORRECTION knob and the SCALE knob for setting the proper map scale. The LIGHT rheostat controls the brightness of illumination of the map. The PATH ON switch turns on the selsyn transmitter. On the right wall is the amplifier switch, and under the cover are knobs for the AMPLIFICATION and COMPENSATION potentiometers which control the bearing angle servo system.

A plotting board is provided for positioning the map in the plotter.

The PM-3 converter supplier three-phase alternating current at 220 Hz and 65-75 volts to the gryo motor of the KM-2 course indicator.

The MG-12 motor-generator supplier 500-Hz alternating current at 110 V to the calculating and resolving components.

The Yantar'-Trassa apparatus is controlled from a control panel in the vehicle. The control panel of a command and staff vehicle is shown [not reproduced].

1.2.2 The TNA-2 Tank Navigation Apparatus

The TNA-2 apparatus determines the positional coordinates and bearing of the vehicle while it is in motion. The apparatus comprises a GPK-52 gyroscopic course indicator, a path sensor, a coordinator, a control panel, two course indicators for the driver-mechanic (some types of vehicle may have only one) and a PT-200Ts11 converter.

The GPK-52 gyroscopic course indicator measures the angular displacement of the vehicle and calculates its bearing angle. It consists of a gyroscopic unit in gimbals, an azimuthal correction device, a horizontal correction device, a mechanism for setting the initial bearing and a selsyn transmitter for the angular servo system.

The gyroscopic unit consists of a three-frame gyroscope, to the axis of whose inner frame is attached a bimetal compensator and whose gyro case (inner frame of the gyroscope) has a compensating screw which is used to adjust the gyroscope at the plant.

The azimuthal correction unit consists of a torque motor and two potentiometers located on the control panel. One of the potentiometers has a scale graduated from 0 to 90 degrees of latitude, while the other is a correction potentiometer for fine adjustment to the latitude in which the apparatus is being used.

The horizontal correction apparatus consists of a liquid pendulum switch and a torque motor for horizontal correction.

The initial bearing angle setting mechanism includes an electric motor and a gear box with a high gear ratio which connects the motor to the rotor of the selsyn transmitter. The motor is controlled by a potentiometer, whose COURSE SETTING knob is located on the coordinator.

The rotor of the selsyn transmitter is rigidly attached to the outer frame of the gyroscope and the stator is attached to the chassis of the vehicle, making it possible to measure angular displacement.

The path sensor measures the speed of the vehicle. It includes a selsyn transmitter and a shaft with a gear box, which is connected by a flexible shaft to the speedometer.

The coordinator continuously calculates the position coordinates and bearing angle of the vehicle and indicates them. The front panel includes scales for the X and Y coordinate registers, a button for setting the initial coordinates, a COURSE scale with a scale division of 1.00 for a coarse bearing readout, a scale with a division of 0.01 for a fine readout, and the COURSE CORRECTION dial. On the front wall of the coordinator case are a knob for setting the path correction coefficient, a knob for setting the course (bearing angle) and a switch for setting the X and Y coordinates.

On the control panel are the CONV. switch, which turns on the converter and starts up the gyro course indicator, the SYSTEM switch, which turns on the power to the calculating and resolving devices, and the azimuthal correction (latitude adjustment) potentiometers.

The course indicator also gives a duplicate coarse reading of the bearing angle from the coordinator. It consists of a selsyn receiver to the axis of which is attached a needle, a fixed dial showing direction and a movable ring with an index scale.

The PT-200Ts11 converter supplies three-phase AC at 400 Hz and 36 V to the gyro course indicator and the calculating and resolving devices.

1.2.3. The TNA-3 Tank Navigation Apparatus

The TNA-3 apparatus determines the position coordinates and bearing angle of the vehicle while it is in motion, the direction to the destination and the distance to it along the coordinate axes. The apparatus comprises the MAYAK bearing system (gyroscopic course indicator, control panel and PT-200Ts11 converter), a path sensor, a coordinator and a course indicator.

The TNA-3 apparatus can operate in two modes:

--solution of the first and second navigation problems for a moving vehicle;

--built-in test mode, allowing system operation and accuracy of solution of problems to be determined.

The TNA-3 differs from the TNA-2 in its use of pulse (digital) calculating and resolving devices to solve the navigation problems.

The gyroscopic course indicator measures the angular displacement of the vehicle. It consists of a three-frame vacuum gyroscope, azimuthal and horizontal correction units, a two-channel servo-selsyn system which transmits the bearing angle, and a heating system which goes into operation when the surrounding temperature falls to 5° C or below.

The use of a vacuum gyroscope with high rotor speed, a high-accuracy selsyn transmitter and a system for heating the gyro casing give the MAYAK system considerably greater accuracy than the GPK-52 and KM-2 gyroscopic course indicators.

The control panel is used for adjusting the bearing system. Under a cover are two azimuthal correction potentiometers: the latitude potentiometer with a dial graduated in degrees of north latitude (0-90°) and an EL. B. [electrical compensation] potentiometer whose two-sided scale has 200 divisions and which is used for fine latitude correction.

The path sensor is a digital speed sensor which produces (with allowance for the path correction coefficient) one pulse per meter driven by the vehicle, the rate of the pulses thus being proportional to the speed of the vehicle. In addition, the course sensor emits pulses which indicate the sign of the speed (forward or backward).

The coordinator calculates the current coordinates and bearing angle of the vehicle, the direction to the destination and the remaining distance on the coordinate axes, and also monitors operation of the system components.

On the front panel of the coordinator are indicator and control devices: two dials for the X and Y registers, two dials for the distance remaining to the destination (ΔX and ΔY), a coarse bearing angle scale and a movable scale to show the angle to the destination, a dial for fine bearing angle readings, a path correction dial, a SYSTEM switch to turn on the entire system, an OPERATE-TEST switch for mode of operation, a START button which starts the test mode, a switch which sets the scale of the X and Y registers at 1 or 10 meters, a COURSE SETTING knob for setting the original bearing angle, a CORRECTION SETTING knob for setting the path correction coefficient, switches for setting the original X and Y coordinates, a switch for setting the distance coordinates $\Delta X_{destination}$ and $\Delta Y_{destination}$, and a knob for setting X, Y, ΔX and ΔY located on the left sidewall of the coordinator.

The course indicator duplicates the coarse bearing angle dial. It has a fixed dial with a needle showing the bearing of the vehicle and a movable ring with an index to show the assigned direction of movement.

1.2.4. The GPK-59 Directional Gyrocompass

The GPK-59 directional gyrocompass is a navigational gyroscopic course indicator which is designed to assist in driving a vehicle over a specified course under difficult orientation conditions. The directional gyrocompass comprises a GPK-59 gyroscopic course indicator and a PAG-1F converter.

The main component of the gyroscopic course indicator is a three-frame gyroscope, on the outer frame of which is a graduated compass dial. On the glass housing of the GPK-59, which is rigidly fastened to the vehicle, is a vertical indicator mark which is used to determine the direction of movement of the vehicle.

The numbers on the dial are hundredths of an angle gage division (e.g. the number 15 represents a course of 15-00). In addition, the dial shows the directions north, south, east and west.

On the front panel is the know for the caging device which is used to arrest the gyroscope. Screwed into the front panel is a screwdriver with is used for latitude adjustment of the course indicator. For this purpose, it is unscrewed from the panel and inserted into a recess in the panel, which is covered by a plug, when the bearing is zero.

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HANDBOOK EXPLAINS DESIGN, LAYOUT OF TANK NAVIGATION SYSTEMS

Moscow TANKOVYYE NAVIGATSIONNYYE SISTEMY in Russian 1978 signed to press 2 Mar 78 pp 1, 2, 3-4, 16, 36-37

[Title page, annotation, introduction, and excerpts from book "Tankovyye Navigatsionnyye Sistemy" by M. I. Kuznetsov, V. K. Presnov, and L. I. Surat]

[Excerpts] Title Page:

Title: TANKOVYYE NAVIGATSIONNYYE SISTEMY
(Tank Navigation Systems)
Publisher: Voyenizdat
Place and Year of Publication: Moscow, 1978

Signed to Press Date: 2 March 1978

Number of Copies Published: 14,000

Number of Pages: 120

Annotation: This handbook describes various types of navigation systems used in the army. The book gives their specifications and explains how to use them when tank subunits are performing tactical missions.

The handbook is designed for officers, engineering-technical personnel, and specialists of the Soviet Army whose work in the service involves practical application of navigation equipment and also for cadets at military schools and college students who are studying armored equipment.

Table of Contents:

Introduction

The Communist Party and Soviet Government devote considerable attention to strengthening the country's defense capability and supplying the Ground Forces with the latest military hardware. The combat performance and maneuverability of modern tanks have improved greatly in recent years. Under conditions of modern battle tank subunits and units make broad use of maneuvering along the front and in depth to perform their combat missions, which increases the role of marches in troop combat actions. Troops carry out movements primarily at night or in conditions of limited visibility, usually on unfamiliar terrain.

For this reason the control of subunits and units to see that they reach their destination on time is much more important. The usual techniques for orientation on the terrain under complex conditions (nighttime, fog, wooded and steppe terrain, poorly developed road networks, and the like) by comparing terrain objects and landmarks with their representations on a map creates difficulties and does not always insure exact orientation and timely performance of combat missions.

Under such conditions the best way of orientation on the terrain is to use the ground navigation systems that have been supplied to subunits of tank and motorized rifle forces.

The availability of navigation systems enables commanders and staffs to do the following:

a. confidently scout the enemy to great depth;

b. lay field roads for troops over unfamiliar terrain;

c. know the position of the subunits on the march and their battle formations in offensive and defensive fighting at any moment;

d. determine evacuation routes and repair points when organizing tank technical services during battle.

This handbook reviews the principles of solving navigation problems, shows the capabilities of the types of navigation apparatus available to the troops and how to use them in solving tactical problems, and gives practical recommendations on work with the apparatus in the field.

A knowledge of the capabilities of the apparatus and methods of use will help commanders and staffs of subunits and units control their forces more accurately under the complex conditions of modern battle.

The book is designed for officers and sergeants who are familiar with the layouts of the navigation apparatus to the extent of existing manuals and regulations.

The present handbook is the first attempt to set forth ways of using the navigation apparatus, so the authors will gratefully accept all comments and suggestions for improving the content and presentation of the material.

1.2. Types of Tank Navigation Systems and Their Designations

The following types of navigation systems are used in tank and motorized rifle subunits and units to solve navigation problems:

a. the Yantar'-Trassa tank navigation apparatus;

b. the TNA-2 tank navigation apparatus;

c. the TNA-3 tank navigation apparatus;

d. the GPK-59 directional gyroscope.

The set of equipment in the tanks includes the following articles for working with this navigation equipment:

a. the PAB-2A artillery director with an ANB-1 azimuthal crossbeam;

b. a measuring tape 20 or 50 meters long;

c. a milrule or caliper.

Directional angles or side angles to targets are measured by a special angle gage mounted on the vehicle. Azimuthal indicators are used for this purpose in tanks.

We will briefly describe the general layout and control elements of the navigation systems and instruments listed above.

Table 1.1

	Volume of Navigation Data			Components of Apparatus				Time of Continuous Operation without Reorientation	Time Needed To Ready for Use
	Coordinates X and Y	Course (Directional angle α)	Direction to Destination	Road Sensor	Course (Directional Angle) Sensor	Computing Unit	Map-board		
Yantar'-Trassa	X and Y with mean quadratic error of 1.5% of distance covered in 7-8 hours	Rough for α, Exact for O_{tp}	--	Electromechanical off Running Gear	Directional Gyro (KM-2), Drift of 167 d.u. in 7 hrs	Electromechanical, Error Not More Than 0.2 Percent	Combined with Plotter for Maps on Scales of 25,000, 50,000 and 100,000	7-8 hrs	15-20 min
TNA-2 and GPK-59	X and Y with mean Arithmetic Error 1.3% of S in 3-3.5 hrs	--	--	" "	GPK-52 Directional Gyro, Drift of 20 d.u. in 30 min	" "	--	3-3.5 hrs	10-15 min
GPK-									
GPK-52	--	Rough for O_{tp}	--	--	GPK-59 Directional Gyro and PAG-1F Convertor, Drift of 40 d.u. in 30 min	--	--	1.0-1.5 hrs	5-10 min

11176
CSO: 1801

SOVIET COMMENTS ON U.S. EMPLOYMENT OF V/STOL AIRCRAFT

Moscow ZARUBEZHNOYE VOYENNOYE OBOZRENIYE in Russian No 5, May 79 signed to press 4 May 79 pp 59-62

[Article by Col M. Panin: "Views on Utilization of VTOL Aircraft"]

[Text] The U.S. Navy, placing priority emphasis on increasing the navy's combat strength, devotes considerable attention to the development of naval aviation, and in particular to the development of a V/STOL aircraft. In the opinion of U.S. military specialists, such an aircraft can be used to perform the following missions: close air support of amphibious landing forces, attacking surface ships, conduct of tactical air reconnaissance, and performance of ASW and antiaircraft defense of convoys and task forces. Adoption of such an aircraft will make it possible to standardize the force of embarked aircraft, to place aircraft on ships of various types and to terminate further construction of costly large aircraft carriers, to facilitate servicing and maintenance, substantially to reduce preflighting time and to lessen the dependence of flight operations on weather conditions.

Efforts to develop a V/STOL aircraft, which began in the United States immediately after World War II, are continuing today. At the beginning of the 1950's a U.S. company, Convair, designed and built an experimental model of the XFV-1 "Pogo" aircraft, which had vertical takeoff capability. The delta wings and two cruciform tail fin surfaces carried shock struts. The first vertical takeoff (to a height of several meters above the ground) took place in August 1954. The aircraft made a total of only approximately 70 takeoffs and landings. Further development of the aircraft was subsequently terminated due to technical difficulties.

Many different V/STOL aircraft designs developed by leading U.S. and other aircraft companies and corporations did not advance beyond the experimental stage. Only the British-developed P.1127 Kestrel ground attack-reconnaissance aircraft attracted the attention of the U.S. military (the United States purchased six aircraft) and was submitted to testing for evaluation in navy squadrons in order to determine the possibilities of its utilization as an embarked aircraft. It made its first landing on a moving aircraft carrier in 1966, but it made a total of only 22 flights from the aircraft carrier "Independence" and 11 from the amphibious assault ship "Relay."

Test results confirm the opinion of U.S. military experts that the Kestrel was capable of operating from the deck of a ship and was entirely compatible with the existing aircraft equipment of aircraft carriers and other aircraft-carrying ships. As is noted in the foreign press, however, due to its poor performance characteristics it was not adopted either by carrier aviation or by Marine aviation.

In Great Britain the GR.1[1] Harrier aircraft was developed from the Kestrel aircraft. U.S. naval authorities took an interest in this new aircraft. They ordered 12 Harriers for the Marines (which were given the U.S. designation AV-8A).[2] In April 1971 these aircraft were delivered to Beaufort Air Base (South Carolina), and by year's end 11 Marine pilots had been trained to fly them.

In the fall of 1971 the U.S. Navy proceeded to test and evaluate the effectiveness of the AV-8A, as well as to develop tactics of close air support of infantry, air combat, and flight operations from shipboard.

In October 1971 tests were conducted at China Lake (California) to determine the aircraft's effectiveness in performance of the close air support mission. According to information in the U.S. press, in a period of 7 hours and 12 minutes six AV-8A aircraft flew 37 bombing sorties, demonstrating, in the opinion of U.S. naval authorities, fairly high mobility, which was achieved primarily by shortening aircraft combat mission turnaround time.

Procedures for flight operations from unequipped landing areas (highways, dirt strips) were developed in January and March 1972.

At the same time they were testing the possibility of employing the Harrier in a fighter version. At the beginning of 1973 test flights were flown at Point Mugu (California) to determine the Harrier's combat capabilities in an encounter with enemy fighters. As was noted in the foreign press, out of 16 air engagements with the F-14 Tomcat fighter, the Harrier won six, while seven were standoffs.

Test flights began in January 1972 from the deck of the amphibious assault ship "Guam," to work out problems of combat employment of aircraft-carrying ships on a special program (employment of V/STOL aircraft simultaneously with helicopters). These tests continued up to 1974. The result was the conclusion that flight operations by Harriers and helicopters were entirely compatible and that all problems connected with servicing, maintenance and control in the performance of various combat missions could be easily resolved.

Several specific features in the operations of the deck crew were noted during these tests. For example, in view of the fact that the jet exhaust from the engine of the AV-8A is directed downward, personnel employed long poles to position wheel chocks.

Seeking to demonstrate the versatility, reliability and combat capability of this aircraft, at the end of 1976 the U.S. Navy presented a demonstration of its performance characteristics and combat capabilities. A squadron of these aircraft (13), based on the aircraft carrier "Franklin D. Roosevelt," transferred to the amphibious assault ship "Guam" (both ships were members of the Sixth Fleet, stationed in the Mediterranean), after which the latter proceeded to the Indian Ocean (through the Suez Canal). During this voyage the aircraft flew various training missions. When the amphibious assault ship reached the shores of East Africa, the aircraft flew to an airfield in Kenya, made a demonstration overflight over Nairobi, and then returned to the amphibious assault ship, which steamed back to the Mediterranean. The squadron then returned to its aircraft carrier.

Publicizing this 9,000 kilometer cruise and drawing particular attention to the virtues of this aircraft (including the absence of serious malfunctions during the entire voyage), the U.S. press at the same time noted the complexity of its operation and maintenance and stressed the fact that there were some design deficiencies which, alongside difficulties in control, are the principal causes of numerous air mishaps. Judging from materials in the British journal FLIGHT INTERNATIONAL, for example, 32 air mishaps, claiming 11 lives, occurred during operation of AV-8A Harrier aircraft by the U.S. Marines (as of October 1978). Its poor performance characteristics are also noted (see table) [not translated: table contains characteristics of the aircraft referred to in the text].

In connection with this the United States developed, on the basis of the Harrier, a design of a V/STOL aircraft, the AV-8B. Two experimental models have been built up to the present time, flight tests on which commenced in November 1978.

According to information in the U.S. press, the AV-8B has better performance characteristics than the AV-8A (see table). Its payload and range were increased by employing new materials and redesigning certain assemblies and equipment. In addition, its electronic equipment and armament have been modernized, plus other changes which increase the aircraft's reliability and facilitate operation and maintenance.

Judging from the latest reports in the foreign press, however, the future of the AV-8B is doubtful, in connection with development of the A-18. The project failed to receive continued development appropriations for 1980.

According to reports in the Western military press, ground tests are presently being conducted in the United States on the XFV-12A V/STOL aircraft (developed on a Navy contract in a fighter-attack aircraft version). It differs in design from existing aircraft of this type. Its aerodynamic design is of a "canard" type with semi-delta wing (see figure) [figure omitted]. It is powered by a Pratt & Whitney F401-PW-400 turbofan engine. It is designed to reach a top speed in excess of Mach 2. This aircraft's principal specifications and performance characteristics are listed in the table.

As is noted in the foreign press, the XFV-12A employs a new principle of generating lift during vertical takeoff with the aid of an ejector system consisting of one ejector and two diffusor flaps. A stream of hot gases from the engine enters the flap channels and, passing through them, is ejected through nozzles into slots between the flaps. An area of reduced pressure is created above the upper surfaces of the wing and tail. The jet exhaust stream is deflected downward with the aid of diffusor flaps, carrying along ambient air, and generates 50% more lift than is generated by engine thrust.

It is reported in the U.S. press that the U.S. Navy is studying the possibility of replacing by the end of the 20th century the current embarked aircraft, even helicopters, with a new V/STOL aircraft to be developed in the following versions: A -- a subsonic multi-role aircraft capable of replacing the E-2, S-3, C-2, A-6 fixed-wing aircraft and the CH-46 helicopter. It would perform missions of long-range radar detection, antisubmarine warfare, transport, mid-air refueling, carrying Marine assault troops ashore, reconnaissance, etc. B -- a supersonic fighter-attack aircraft to replace the F-14, F-18, A-6, AV-8A and B. C -- an ASW aircraft which will be employed in place of LAMPS helicopters.

FOOTNOTES

1. For more detail on the Harrier aircraft and the possibilities of its combat employment see ZARUBEZHNOYE VOYENNOYE OBOZRENIYE, No 7, 1974, pp 54-59 -- Ed.

2. At the present time, according to reports in the U.S. press, Marine aviation is operating 80 AV-8A Harrier aircraft -- Ed.

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CSO: 1801

SOVIET COMMENTS ON WESTERN ANTIMINE SHIP CAPABILITIES

Moscow ZARUBEZHNOYE VOYENNOYE OBOZRENIYE in Russian No 5, May 79 signed to press 4 May 79 pp 63-68

[Article by Capt 1st Rank A. Daniyelyan and Engr-Capt 2d Rank A. Boyko: "Antimine Ships"]

[Text] As a rule the shipbuilding programs of the majority of capitalist countries specify modernization of obsolete and construction of new antimine ships.

According to information in the foreign press, in designing new ships of this type efforts are made to achieve a substantial decrease in the level of their physical fields, to increase the resistance of hulls and equipment to the effects of explosives, to provide excellent maneuver capabilities, to increase course stability against wind and current, and to decrease tendency to yaw at speeds of from 1 to 6 knots. Toward this end fiberglass hulls and stabilizers are employed, supplementary low-noise electric propeller drives and water jets are developed, sophisticated navigation systems are installed, and combat information-control systems are adopted.

According to NATO member nation naval experts, wood, which long was considered the principal nonmagnetic material for building minesweeper hulls, possesses a number of shortcomings. They include in particular poor sound-absorbing properties, as well as considerable cost connected with fire safety and maintenance in the process of extended use. Fiberglass, although comparatively expensive, is considered to be the most promising material.

In the last decade the navies of the capitalist nations have been building primarily mine-hunting minesweepers which, in the opinion of foreign experts, are versatile antimine ships capable of destroying mines of any type. In addition, they are more effective in shallow water than conventional minesweepers. Therefore the majority of NATO countries are converting some of the minesweepers built in the 1950's into minesweeper-minehunters, and are also building new ships of this type (Table 1).

Table 1. Principal Specifications of Minesweeper-Minehunters of the NATO Nation Navies (According to "Jane's Fighting Ships," 1978-1979)

Class (Year Built)	Quantity	Displacement, tons	Principal Dimensions, meters: L -- L -- length B -- beam D -- draft	Propulsion Plant, Horsepower	Full Speed, Knots	Crew Complement	Armament
			United States				
Minesweeper-minehunter design (construction scheduled to begin in 1980)	19	2200	L -- 73 B -- 13.5 D -- 3.4	6800	18	Approximately 100	
			Great Britain				
"Brecon" (2 under construction)	12	725	L -- 60 B -- 9.9 D -- 2.2	3540	17	40	40 mm gun; 193M sonar; PAP-104 self-propelled remote-controlled underwater units -- 2; contact, acoustic and electromagnetic (noncontact) sweeps
"Wilton" (1973)	1	480	L --46.3 B -- 8.8 D -- 2.5	3000	16	37	40 mm gun; 193M sonar; contact and acoustic sweeps
("Shoulton") 1953-1957)	15	425	L -- 42.7 B -- 8.8. D -- 2.5	3000	15	29	Same
"Leigh" (1953, 1955)	2	164	L -- 30.5 B -- 6.5 D -- 1.7	700	13	15	
			France				
"Eridan" (keel laid in 1976, scheduled for completion in 1981)	15	544	L -- 49.1 B -- 8.9 D -- 2.5	2280	15	22-45	20 mm guns; DUBM-21A sonar; two PAP-104 self-propelled remote-controlled underwater units

Table 1 (cont'd)

Class (Year Built)	Quantity	Displacement, tons	Principal Dimensions, meters: L -- length B -- beam D -- draft	Propulsion Plant, Horsepower	Full Speed, Knots	Crew Complement	Armament
			France (cont'd)				
"Circe" (1972-1973)	5	510	L -- 50.9 B -- 8.9 D -- 3.4	1800	15	48	Same
"Berneval" (seven ships converted since 1975)	13	780	L -- 52.1 B -- 10.7 D -- 3.2	1600	14	58	40 mm guns; DUBM-21A sonar; two PAP-104 self-propelled remote-controlled units; contact and acoustic sweeps
			FRG				
"Lindau" (under conversion since 1975)	12	420	L -- 49.7 B -- 8.3 D -- 2,5	4000	16.5	46	40 mm gun, two 20 mm guns; 193M sonar; two PAP-104 self-propelled remote-controlled underwater units
			Italy				
Minesweeper-minehunter design (construction of 4 ships has been contracted)	10	470	L -- 49.9 B -- 9.4 D -- 2.5	1600	15	39	40 mm gun; AN/SQQ-14 sonar; two PAP-104 self-propelled remote-controlled underwater units; contact sweep

The U.S. Navy has gone over almost entirely to helicopter sweeping, based on the positive results of antimine activities in Vietnam waters and in the Suez Canal. At the present time the U.S. Navy has only three minesweepers in line service, while 22 are in reserve.

Since the mid-1970's the United States has been developing antimine ships of a new type, designed primarily to combat deep mines. They will be equipped with antimine helicopters and improved equipment for minehunting and sweeping. Appropriations for construction of the first ship of the new class are to be allocated in the 1979/80 fiscal year, with appropriations for four additional ships in 1981/82 and 1982/83 fiscal years. It is estimated that construction of one such ship will cost approximately 100 million dollars.

The British Navy contains 18 minesweeper-minehunters of the "Wilton" (1), "Leigh" (2), and ("Shoulton") (15) classes, plus 21 conventional minesweepers of the ("Ton") (18) and ("Khem") (3) classes.

Naval experts consider it essential to expand the minesweeper-minehunter fleet by building a series of antimine ships of the "Brecon" class, development of which is based on the design of the experimental minesweeper-minehunter "Wilton," commissioned in July 1973. Its hull is of single-ply fiberglass. Blast-resistance tests showed that a hull of single-ply plastic is considerably stronger than a laminated hull. To be true, it cost 43% more than a hull of wood or aluminum alloy. Experts believe, however, that 20% less work will be required to maintain a fiberglass hull than a wooden hull, and the 15-year service life of a fiberglass hull evens out with the cost of building hulls of both types.

Considering the experience of construction and operation of the minesweeper "Wilton" (it took part in clearing mines from the Suez Canal), the keel of the first unit of a new class was laid in 1975 -- the minehunter "Brecon" (launched in June 1978). In May 1977 construction began on the second unit of this class -- the "Ledbury." The hulls of these ships are being fabricated of fiberglass, employing the technique developed for the "Wilton."

Plans call for installing a 193M sonar for seeking underwater objects, and two French-made PAP-104 self-propelled remote-controlled underwater units for final classification and destruction of mines.* There will also be a capability to equip the ship with one contact and two noncontact sweeps (acoustic and magnetic), which will make it possible to employ the ship as a conventional minesweeper. In some cases mines can be destroyed by combat swimmers.

As follows from data published in the foreign press, in arming the minesweeper-minehunters under construction, naval experts have given preference to the French ("Skuber Mor") mine search and destruction system.

On the instructions of the British Admiralty, construction began in the 1960's of minesweepers based on air-cushion vessels. In the course of testing the following advantages of these craft over water-displacing minesweepers were revealed: a high degree of blast resistance, insignificant acoustic and magnetic fields, high speed of travel to the sweep area, simplified servicing and maintenance because the minesweeper can go on shore under its own power. During test sweeping naval experts devote particular attention to the question of placing and removing sweeps with the aid of

* See ZARUBEZHNOYE VOYENNOYE OBOZRENIYE, No 1, 1977, pp 87-92; No 4, 1975, pp 80-82 -- Ed.

of organic equipment, as well as placement of sweeping gear on the ship's superstructure.

The SR.N4 Mk4 air-cushion minesweeper (length 39.7 meters, beam 23.8 meters, weight 220 tons, weight of sweep equipment 35 tons, speed under no-wind and calm-water conditions 69 knots) is equipped with an ("Oropeza") contact sweep, an electromagnetic and acoustic sweep, two side-viewing sonars and a 20 mm gun for destroying surfacing mines. Endurance is 9.3 hours on 40 tons of fuel and simultaneous operation of three 3,800 horsepower engines. It is reported in the foreign press that prior to heading out for sweep operations sweep equipment is assembled on the basis of the assigned mission and is taken on board in the form of modules.

The SR.N4 air-cushion vessel, utilized as a minesweeper-minehunter, has approximately the same specifications as the SR.N4 Mk4. Weight of its sweep equipment (two side-viewing sonars, a DUBM-40 sonar, a PAP-104 underwater unit, charging unit, as well as six buoys with television surveillance sensors) is 13.5 tons.

Mine hunting and sweeping can be performed in rough seas. Sweeping towing or minehunting speed depends on the type of sweep or sonar, as well as on the weight of the air-cushion minesweeper. For example, side-viewing sonar towing speed (with the air-cushion vessel weighing 181 tons) is 20 knots at shallow depth and 16.5 knots at greater depths, the ("Oropeza") deep-submerged contact sweep (air-cushion vessel weighing 184.9 tons) -- 11 knots, and electromagnetic (190.4 tons) -- 8.5 knots.

An on-board navigation system containing a special computer is utilized in sweeping and minehunting. It automatically controls the air-cushion minesweeper under certain weather conditions. The ship's position is determined on the basis of navigation reference points.

British naval experts claim that in spite of poor endurance, air-cushion vessels can be successfully employed as minesweepers, minesweeper-minehunters, as well as mine carriers. Proceeding from this, they reached an affirmative conclusion on the prospects for utilization of these ships in the NATO nation navies.

The majority of the French navy's antimine ships were built in the 1950's. According to the foreign press, the most modern of these are the minesweeper-minehunters of the "Circe" class (Figure 1). Their hulls are wooden and boast improved blast resistance and survivability. All equipment is manufactured of nonmagnetic alloys and is mounted on shock absorbers to reduce noise during operation.

The propulsion plant is remote controlled and does not require the continuous presence of operating personnel in the engine room. Due to the 2.4 meter diameter propellers, the ship has a comparatively high precavitation speed. It is equipped with a DUBM-20A sonar (total weight 5,700 kg), which operates on frequencies of 100-400 kHz. Radiated power is 4.5 and 7.5 kw.

In view of the favorable results obtained in operating minesweeper-minehunters of the "Circe" class, the French Navy decided to convert between 1975 and 1979 11 of 13 minesweepers of the "Berneval" class with conventional sweep equipment into minesweeper-minehunters, with the remainder to be converted after 1979. They will be equipped with a DUBM-21A sonar (weight 3,100 kg, lightweight version of the DUBM-20A sonar with the same performance characteristics) and PAP-104 self-propelled remote-controlled underwater units. Combat swimmers with individual gear will be able to take part in destroying detected mines.

According to an agreement reached in 1924, the navies of France, the Netherlands and Belgium plan to build in the period 1977-1985 not less than 40 minesweeper-minehunters in a joint project, based on the design of the minesweeper-minehunter "Circe." Each of these countries will supply component equipment and armament for this project: the Netherlands -- the main propulsion units; Belgium -- electrical equipment; France -- DUBM-21A minehunting sonar, improved PAP-104 units (two on each ship), electronic equipment and armament, and will also provide the fiberglass hull technology. Pursuant to the agreement, the ships will be built in the shipyards of the partner countries, while the first unit, the minesweeper-minehunter "Eridan," construction on which began in December 1976, is being built in France. The French and Dutch navies plan to build 15 apiece, while the Belgian Navy plans to build 10 minesweeper-minehunters of this class. The first three ships for the French Navy and the first five for the Dutch Navy are scheduled to be commissioned by the end of 1982, and the first ship for the Belgian Navy -- in 1981.

The West German Navy is converting 12 coastal minesweepers of the "Lindau" class into minesweeper-minehunters (three have already been commissioned, Figure 2). These ships are to be equipped with British-made 193M sonars and two PAP-104 units. They will carry a team of combat swimmers, the noncontact sweeps will be removed, 560 kw diesel generators and two electric motors will be installed, to power a variable-pitch propeller, to provide slow minehunting speeds. In order to reduce equipment operation noise, the diesel generators, pumps, inverters and auxiliary machinery are being mounted on flexible concrete foundations.

Hull work connected with converting these ships includes the following: installation of a minehunting sonar well, lengthening of the superstructure to accommodate additional crew quarters and facilities, installation of a crane with electrohydraulic drive and two-part telescoping boom (load-lifting capacity of approximately 1 ton) for raising and lowering the PAP-104 units. The ship's ability to lay a precise course will be increased by installing a British Mk20 (G) automatic course plotter and navigation radar. The conversion program is scheduled for completion at the beginning of 1980.

In June 1977 the West German Bundestag budget committee approved a request by the Navy for development of the "Troika" remote controlled sweeping system, which is to be employed in the North Sea and the Baltic. Testing has now been completed on the system prototype, and delivery of six units to the navy is scheduled in 1980-1981. The system includes a control ship and three remote-controlled self-propelled F1 sweep craft (Table 2). The system seeks out and sweeps moored and bottom mines with contact and noncontact firing mechanisms in a strip 300 meters wide and at depths of 6-35 meters.

Table 2. Principal Specifications and Performance Data for Control Ship and Sweep Craft

Specifications and Performance	Control Ship	Sweep Craft
Displacement, tons	430	99
Principal dimensions, m:		
length	45.1	27
beam	8.3	4.6
draft	2.6	2.3
Propulsion plant and output, horsepower	Diesel, 3340	Diesel generator, 320
Maximum speed, knots	16	9.4
Armament	40 mm gun	—
Crew complement	44	—

The sweep craft comprises an acoustic sweep which includes one towed and two echosounder transmitters built into the craft's hull. At the same time the hull itself serves as the core of a solenoid the windings of which are located in the bow and stern, and thus it constitutes an electromagnetic sweep.

Plans call for converting six "Lindau" class coastal minesweepers into control ships, the condition of the hulls of which, in the opinion of naval experts, will enable them to remain on the line for 10 to 12 years yet. The plan calls for installing on these vessels a control center and remote control system radar antenna masts, radio gear for transmitting commands, and a 193M sonar for minehunting.

One such ship will be able to control three sweep craft simultaneously at wind velocities up to 18 m/s and in rough seas. There will also be a capability of control from a shore station, mounted on four vans and one trailer (the first two contain the command post and radar, the two others carry personnel, and the trailer -- command post power supply).

It is believed that the "Troika" system is equivalent in capabilities to 2.5 harbor minesweepers of the "Schuetze" class which are currently in service. Thus the six units scheduled for construction should replace 15 minesweepers. Personnel requirements will be reduced by 50%. The cost of building one "Troika" system is 55% cheaper than the cost of building a corresponding number of conventional minesweepers with the same performance capabilities. A total of 85 million West German marks have been spent on system development. The total cost of the contract (six control ships and 18 sweep craft) is 350-400 million West German marks. A particular advantage of this system, as is stressed by the foreign press, is the smaller probability of personnel being killed by the explosion of mines during sweeping, since sweeping will be performed by the remote-controlled sweep craft.

The Italian Navy possesses 44 minesweepers, including four fleet, 30 coastal and 10 harbor minesweepers which have been in service less than 20 years.

In 1975 the Italian legislature approved a 10-year shipbuilding program, which calls for the navy to receive 10 new-type minesweeper-minehunters and 10 converted from conventional minesweepers. Due to financial difficulties, however, construction of six new-type minesweepers has been postponed to a later date. It is planned to equip the new Italian minesweeper-minehunters with U.S.-developed AN/SQQ-14 sonars (manufactured in Italy under license from General Electric) and PAP-104 units. The hulls will be fabricated of fiberglass, and the ship's machinery -- of nonmagnetic materials. Four minesweepers are to be built by the end of 1984.

It follows from the above that naval leaders in the nations of the aggressive NATO bloc continue to consider antimine ships to be the principal carriers of active means of destroying mines in sea theaters of military operations.

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